DOCUMENT RESUME

ED 453 058 SE 064 597

AUTHOR Miau, Jiun-Jih; Chiu, Huei-Huang; Wu, Yuh-Yi; Lin, Chin-E; Choi, Siu-Tong; Yang, Shih-Ming; Jeng, Syh-Tsang

TITLE Development of an Aviation Maintenance Curriculum in an Aerospace Engineering Department.

PUB DATE 1999-08-00

NOTE 6p.; Paper presented at the International Conference on Engineering Education (Prague, Czech Republic, August 10-14, 1999).

AVAILABLE FROM For full text: http://www.ineer.org/Events/TCEE1999/Proceedings/papers/221/221.htm.

PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS Aerospace Education; *Aviation Education; *Curriculum Development; Engineering Education; Foreign Countries; Higher Education

IDENTIFIERS *Taiwan

ABSTRACT

This paper describes the motivation of developing the Aviation Maintenance Curriculum, at National Chang Kung University (seven elective courses) contents of the elective courses, and university-industry collaborations developed along with the Curriculum. The curriculum represents an effort to respond to the needs of manpower in the aviation industry in Taiwan. It was developed through two NSC projects funded by the Ministry of Education, China Aviation Foundation, CAA, CASID, China Airlines, EVA Airways, and Air Asia Company. (Author/NB)

Reproductions supplied by EDRS are the best that can be made from the original document.

ED 453 058

Development of an Aviation Maintenance Curriculum in an Aerospace Engineering Department

MIAU, Jiun-Jih, CHIU, Huei-Huang, WU, Yuh-Yi, LIN, Chin-E, CHOI, Siu-Tong, YANG, Shih-Ming & JENQ, Syh-Tsang

Department of Aeronautics and Astronautics, National Cheng Kung University, Tainan, Taiwan 70101, Republic of China,
jjmiau@mail.iaa.ncku.edu.tw

Abstract: The Aviation Maintenance Curriculum consisting of seven elective courses is being offered in the Department of Aeronautics and Astronautics, National Cheng Kung University. This paper describes the motivation of developing this curriculum, contents of elective courses and university-industry collaborations developed along with this curriculum. This curriculum represents an effort of the present authors responding to the needs of manpower in aviation industry in Taiwan.

Keywords: curriculum, aviation, maintenance, aerospace, engineering

1 Introduction

Owing to a strong growth of air transportation in Taiwan, both domestic and international, the airline fleets are expanding at a rapid pace in recent years. Hence, there has been an increasing demand of manpower in the aviation industry at the rate that has not been experienced before. Also, there has been an uprising trend in a significant amount of college students among aerospace engineering major to choose their careers in aviation, and some of them have been employed as aircraft maintenance engineers.

For more than four decades, the aerospace engineering education in Taiwan has focused upon traditional academic disciplines with emphasis on aircraft design. The graduates have commendable academic background and potential in research and development in various engineering areas, but have not been necessary well versed in practical aviation maintenance discipline. By weighing the combined impacts of the current growing aviation industry in Taiwan and the lack of the practical aviation curriculum on the other hand, the present authors proposed to offer a series of elective courses in aviation maintenance in the Department of Aeronautics and Astronautics, National Cheng Kung University, in 1994. These elective courses form the basis of the aviation maintenance curriculum described in this paper. The new initiative gained the start-up support from the National Science Council, and subsequently from other governmental agencies including the Ministry of Education and industrial establishments, such as China Aviation Development Foundation. The purpose of this curriculum is to provide students a comprehensive background in aircraft maintenance which is essential to an aircraft maintenance engineer. In the following, we describe the contents of these courses as well as university-industry collaborations developed along with these courses being offered in university.

2 Description of Curriculum

The curriculum consists of seven elective courses distributed over the period of four years in the undergraduate program. It is designed as a supplement to the undergraduate courses currently offered in the Department of Aeronautics and Astronautics, National Cheng Kung University [1]. The courses in this curriculum are shown below;

2nd Semester	Airplanes	2 credits;
3rd Semester	Aircraft Maintenance	3 credits;
4th Semester	Introduction to Civil Air Transportation Technology	3 credits;
5th Semester	Introduction to Avionics	3 credits;
6th Semester	Practice of Aviation Maintenance	1 credit;
7th Semester	Aircraft Materials	3 credits;
8th Semester	Aircraft Structure Analysis and Testing	3 credits.

http://www.ineer.org/Events/ICEE1999/Proceedings/papers/221/221.htm

BEST COPY AVAILABLE

SE 060 457

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

J. Miau

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

The outline of each of these courses is briefly described as follows.

"Airplanes" is an introductory course for students to familiarize with aircraft systems and subsystems. Topics included are (1) aircraft structures; (2) flight control systems; (3) subsystems of cabin pressurization and air conditioning, autopilot, communication, electric power, fire-protection, flight control (including fly-by-wire), fuel tank, anti-ice/rain, landing gear, lighting, navigation, oxygen, water supply and sewage, auxiliary power unit, and electronics; and (4) aircraft engines of turbojet, turbofan, turbo-prop and turbo-shaft.

"Aircraft Maintenance" is a course for providing students a general background of aircraft maintenance, particularly on inspection methods, management, regulations and safety. Topics included are (1) fundamental concept of aircraft maintenance: maintenance plan and schedule, maintenance control and execution, quality control and certification, logistic, technical documents, reliability control; (2) inspection methods: inspection techniques, levels of maintenance, repair and modification, aircraft inspection, composite material inspection, plastic parts inspection, and aircraft system inspection/maintenance; (3) trouble-shooting practice: introduction of trouble-shooting, procedures of trouble-shooting, trouble-shooting table, examples of trouble-shooting, and intermittent defects; (4) regulations and flight safety; (5) aircraft assembly and adjustment; and (6) hand tooling.

"Introduction of Civil Air Transportation Technology" covers a wide range of basic introductory subjects in aviation, such as (1) history of aviation development; (2) principles of flight; (3) aviation regulations; (4) airworthiness; (5) air traffic control; (6) bilateral agreement negotiation; (7) air transportation management; (8) aircraft maintenance and management; (9) airport management; (10) aviation safety; (11) human factors in aviation; and (12) aviation medicine.

"Introduction to Avionics" offers lecture materials in reference to avionics of modern aircraft, such as Boeing 747-400 aircraft. Topics included are (1) introduction of avionics; (2) electrical and power system; (3) flight data collection system; (4) communication system; (5) navigation system; (6) ground navigation and landing system; (7) flight surveillance system; (8) flight control system; (9) engine control system; (10) flight management system; (11) cockpit instrument and display system; (12) integration of avionics system; and (13) future development in avionics.

"Practice of Aviation Maintenance" is a laboratory course aiming to acquire hands-on experiences on aviation maintenance. Laboratory facilities include a PL-1 trainer aircraft, a sample piece of Boeing aircraft structure section, NT361S flight instrument simulator with computer interface, a three-wheels landing gear system training stand, a hydraulic control system training stand, a jet fuel system training stand, a cabin pressurization system training stand, a JT9D turbofan engine, and a TPE331 turboprop engine with propeller.

"Aircraft Materials" emphasizes current knowledge on fundamentals of aerospace materials. Topics included are (1) introduction to aerospace engineering materials; (2) atomic bonding and coordination; (3) atomic order and disorder in solids; (3) phase equilibrate and reaction rates; (4) deformation and fracture; (5) strengthening and toughening processes; (6) polymer and composites; (7) mechanical testing of advanced composites; (8) aerospace titanium alloys and aluminum alloys; (9) corrosion of materials and surface treatment; (10) conduction and magnetic properties of materials; and (11) aerospace structure design and material selections.

"Aircraft Structure Analysis and Testing" is a course designed to provide students the computer tools and testing methods relevant to aircraft structure maintenance. This course emphasizes integration process of analysis, testing and laboratory practice on aircraft structure maintenance. Topics included are (1) introduction of aircraft structure analysis; (2) computer software application to aircraft structure analysis; (3) visits to aircraft structure maintenance sites; (4) introduction of aircraft structure inspection: stress and strain measurements, and displacement, velocity and acceleration measurements; (5) computer application to signal measurement and reduction; and (6) laboratory practice: stress and strain tests, vibration tests, acoustic measurement, and C-scan composite material testing.

It should be pointed out that all the above courses are being offered in the Department, with the exception of "Practice on Aviation Maintenance" which is under preparation. Laboratory equipment for the course "Practice on Aviation Maintenance" is actively being prepared. Additional funding for the building up of the curriculum infrastructures is in the process of grant application.

3 Aircraft Maintenance Education Workshops

In order to enhance the exchange of ideas and share experiences with lecturers and instructors outside of the department, the authors organized a series of aircraft maintenance education workshops in the past three years. The first workshop was held on January 9 to 11, 1996, with a main theme on planning aircraft maintenance courses in academic schools. In this three-day workshop, several presentations were given. Professor M. J. Williams of Embry-Riddle University presented the aircraft maintenance program of Embry-Riddle University and major activities resulted from cooperation between university, airline companies and government in United States. Mr. A. Akdeniz of Boeing Commercial Airplane Group gave presentations on (1) analysis of aircraft reliability, maintainability and safety, and (2) requirement of aircraft maintenance by Boeing. Mr. R. W. Schultz of Boeing Commercial Airplane Group introduced the training programs of aircraft maintenance at Boeing. It should be mentioned that the two speakers

from Boeing were financially supported by the International Cooperation Program jointly sponsored by CASID (Committee for Aviation and Space Industry Development, Republic of China) and Boeing. Moreover, three speakers from local airline companies gave presentations. They were (1) Mr. Y. L. Lee of Far Eastern Air Transport on "Challenges to Aviation Safety", (2) Mr. Y-H. Fu of EVA Airways on "EVA Airways Quality and Safety Ways", and (3) Mr. L. J. Chang of China Airlines on "Capacity of China Airlines aircraft maintenance and future perspectives".

On March 19, 1997, the second workshop was held in the department with the main theme on how aircraft maintenance education in academic institutions to cope with the manpower needs in the aviation industry. Five papers on this theme were presented. They were (1) "Aircraft Maintenance Training Toward 2003" by Mr. L. J. Chang, China Airline Company; (2) "Improvement on Teaching a Aircraft Structure Course in University" by Professor C. H. Lin, Chung-Cheng Institute of Technology; (3) "Aircraft Maintenance Education in Tainan Technical High School" by Mr. J. Y. Yeh, Tainan Technical High School; (4) "Current Status and Future Perspectives of Aircraft Maintenance Education in University" by Professor J. J. Miau, National Cheng Kung University; and (5) "University-Industry Collaboration on Aircraft Maintenance Training Program" by Mr. Y. Y. Wu, National Cheng Kung University.

On May 12, 1998 the third workshop on aircraft maintenance education was held in the department with the emphasis on how to improve the quality of aircraft maintenance courses in universities, colleges and technical high schools from the aspects of instructors, lecture materials and laboratory facilities. Five presentations were given as follows: (1) "University Education on Aircraft Maintenance Engineering and Management" by Professor J. J. Miau, National Cheng Kung University; (2) "Evaluation and Future Planning of Aircraft Engineering Program in National Hu-Wei Institute of Technology" by Professor Y. L. Tsai, National Hu-Wei Institute of Technology; (3) "Revising the Guidelines of Aviation Maintenance Curriculum for Technical High Schools and Related Issues" by Professor S. H. Chen and Mr. T. T. Wen, China Institute of Technology and Commerce; (4) "Issues on Teacher's Qualifications for Teaching Aviation Maintenance Courses" by Professor C. H. Lin, Chung-Cheng Institute of Technology; and (5) "A Training Program for Teachers in Technical Colleges and High Schools" by Professor Y. Y. Wu, National Cheng Kung University.

The relation between airline companies and academic institutions has been strengthened greatly through these workshops. Furthermore, the benefits realized are that the quality of teaching in universities, colleges and technical high schools has been improved and students with background in aviation maintenance are favored by the industry.

4 University-Industry Cooperation Continuing Education Program

Along with the curriculum offered to undergraduate students in the Department, a university-industry cooperated continuing education program on aircraft maintenance was offered to off-campus individuals in the past two years. This program was financially supported by the Labor Department of Taiwan Provincial Government and China Aviation Development Foundation in response to the urgent needs of manpower in aviation industry. The purpose of this program is to train off-campus individuals to have basic skill and sufficient background knowledge on aircraft maintenance, qualified as entry-level technical personnel in airline companies.

This program was carried out in such a way that in-class lectures were given in the department during evening hours while shop practices were arranged by Air Asia Company in day time. Air Asia Company is a FAA (Federal Aviation Administration, United States) certified aircraft repair station, located in Tainan Airport. This program comprises 887 training hours in total over a period of five months. The in-class lectures cover the subjects on aircraft systems and subsystems, aircraft turbo engines, aircraft maintenance, aircraft instrument, electronics and power systems, and aviation technical English. The shop practices cover the topics on structure repair, electronics repair, component repair, engine repair, and maintenance planning and operation procedure.

Limited by the capacity of facilities at Air Asia Company, this program could take only 20 to 25 trainees each time. Some statistics regarding this program is worth mentioning here. As the program was started in September 1996, 21 trainees were selected from 233 applicants. The education background of trainees range from diploma of technical college to Master degree in engineering. Apparently, this program was so attractive that we were able to select the well-qualified trainees from a large number of applicants. Upon the completion of training program, each of the trainees obtained a job offer. The success of this continuing education program is quite evident.

5 Discussion

Undergraduate students in the department may be benefited from the aviation maintenance curriculum through gaining a comprehensive background in aircraft maintenance. It should be emphasized that this curriculum is designed for students in an aerospace engineering department, who have background of aerospace engineering, i. e. aerodynamics, propulsion, structure and flight dynamics. Those students who are not familiar with basic subjects of aerospace engineering are encouraged to take at least one introductory course of aerospace engineering, for instance, "Introduction to Aeronautical and Astronautical Engineering" offered in the first year of undergraduate curriculum (see also Appendix), prior to these elective courses.

The elective courses of the aviation maintenance curriculum described above are designed to broaden the background of an aerospace engineering student in aircraft maintenance, but do not intend to train a student for obtaining certification or license. The latter consideration is of major interest to technical high schools and colleges which

offer the aircraft maintenance programs that satisfy the regulations of CAA (Civil Aviation Administration, Republic of China) and FAA for license examination. Furthermore, since the aviation technology is of multi-disciplinary in nature, students who are interested in aviation are encouraged to take interdepartmental courses in air transportation management, such as those offered by the Department of Transportation and Communications Management Science in this campus, NCKU. It is worthwhile to mention that collaborations between the faculty members of the two departments have been very successful in recent years through teaching and research projects.

This curriculum represents an effort of the faculty members in the department to respond to the need of manpower in aviation industry. The present authors conceive that this may not be the only solution to answer the problem, but probably an optimal for the following reasons. Although the shortage of manpower in the aviation industry is urgent, the quantity of manpower need is rather uncertain and strongly depends on revenue incomes of airlines companies. Moreover, it should be pointed out that despite of the rapid growth of air transportation in recent years, the size of aviation industry is rather small compared to others, for instance, the automobile industry. Hence, having realized the problem and the constraints above, the authors suggest that offering elective aviation-maintenance courses in an aerospace engineering department is an optimal solution to respond to the current problem. With the addition of these elective courses into the undergraduate curriculum of an aerospace engineering department, students enjoy more flexibility to pursue their career interests.

6 Concluding Remarks

The aviation maintenance curriculum has been successfully established in the Department of Aeronautics and Astronautics, National Cheng Kung University. This curriculum is designed to broaden students' background in aircraft maintenance that may benefit the students who would like to choose their future career in the aviation industry. Successful university-industry cooperation has been developed along with the establishment of the curriculum, such that students gain benefits through on-site visits. A continuing education program was funded to train off-campus individuals who were able to obtain employment in the aviation industry. In summary, the success of the curriculum development lies in the following factors. First, the problem of shortage in aviation manpower is well recognized by the industry, which further draws the attention of the academic institutions and funding agencies. Secondly, the faculty members not only offer class lectures but also keep in good contact with the industry. Finally, the financial supports from governmental agencies and non-profit foundations were the key to establish the laboratories.

Acknowledgement

The work described in the paper are the results of the NSC Projects, NSC 87-2512-S-006-007-EE and NSC-2512-S-006-008-EE. Funding supports from Ministry of Education and China Aviation Foundation for aircraft maintenance laboratory equipment are gratefully acknowledged. Throughout the development of this curriculum supports from other governmental agencies, i. e. CAA and CASID, and industrial organizations, i. e. China Airlines, EVA Airways and Air Asia Company, are also gratefully acknowledged.

Appendix

The undergraduate curriculum of the Department of Aeronautics and Astronautics, National Cheng Kung University, is provided for reference.

The minimum number of credits required for graduation is 145 in total, which include the general courses required by the Ministry of Education of 32 credits, the specialized courses required by the Department of 81 credits and the elective courses of no less than 32 credits.

The specialized courses required by the Departments are described below. In the first year, courses are Introduction to Aeronautical and Astronautical Engineering; General Chemistry; Engineering Graphics; Calculus (I and II, two semesters); General Physics (I and II); General Physics Laboratory (I and II); Machine Shop Practice; Engineering Mechanics (I). In the second year, courses are Introduction to Computer; Engineering Mechanics (II); Thermodynamics (I, II); Mechanical Engineering Drawing;

Electric Circuits and Electronics; Engineering Mathematics (I, II); Mechanics of Materials; Fluid Mechanics; Thermo-Fluid Laboratory. In the third year, courses are Structure and Material Laboratory; Aircraft Engines; Introduction to Control Systems; Heat Transfer; Aerodynamics (I, II); Aircraft Structure (I,II); Off-Campus Practice; Engineering Material Science; Guidance and Control Laboratory; Flight Mechanics. In the fourth year, courses are Aircraft Design (I, II).

The elective courses offered in the Department are given as follows. In the first year, courses are General Chemistry Laboratory; English Listening and Speaking (I,II); *Airplanes** . In the second year, courses are *Aircraft Maintenance** ; Mechanism; Computer Aided Engineering Drawing; Numerical Methods and Applications; Applied Electronics Laboratory; *Introduction of Civil Air Transportation** . In the third year, courses are Theory of Vibrations; Engineering Mathematics (III); *Introduction to Avionics** ; Advanced Mechanics of Materials; Air Traffic Control; Space Mechanics; Computer Analysis for Structural Engineering; System Dynamics Analysis; Viscous Flow; Heat Transfer Application; Introduction to Combustion Engineering. In the fourth year, course are Applied Linear Algebra; Thesis (I,II); Machine

Design; Airport Management; Satellite Technology and Applications; *Aircraft Materials** ; Aircraft Stability and Control; Control System Design; Gasdynamics; Combustion Emission and Control; Air Transportation Management; Introduction to Space System Engineering; Mechanics of Composite Materials; *Aircraft Structure Analysis and Testing**; Numerical Control Machine Theory.

Note: symbol "*" denotes the elective course in the aviation maintenance curriculum.

References

1. *University Bulletin 1997-1998 (English Edition).* National Cheng Kung University, March 1998.